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AUTHOR	Myers, Mark D.
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ABSTRACT

This report discusses a proposed research project to study the integration of video technology to reinforce the National Science Education Standards in Advanced Placement (AP) classes in low socio-economic schools in Indiana. The report begins with overviews of AP in Indiana, the National Science Education Standards, and research relevant to the applications of video technology in science classrooms. Three project objectives are then discussed: (1) to measure the achievement levels of students who are exposed to authentically integrated audiovisual materials; (2) to examine the achievement in AP science classes and look at the effects of video instruction on gender; and (3) to classify students as field-independent or field-dependent and measure achievement levels based on AP test scores and grade point averages. (Contains 26 references.) (MES)

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Section C Authentic integration of video technology to reinforce the National Science Education Standards in Advanced Placement science classes in low socio-economic schools

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A. Introduction

Advanced Placement in Indiana

The Indiana General Assembly passed legislation in 1992 to establish the Advanced Placement Program (APP). Over one-half million dollars was appropriated each year from 1990 to 1997 to encourage Indiana students to complete courses and write the AP examinations. The appropriations have grown to about six hundred thousand dollars annually and funds are allocated to cover fees and costs for AP courses as well as those for math and science (Reed, 2002). Unfortunately, access to Advanced Placement courses has increased in the state of Indiana while examination scores have declined in science. Advanced Placement scores in high poverty urban schools and rural schools are considerably lower than scores of students in other Indiana schools (Bull, 2001). In 2000, the average scores for AP tests in Indiana were one-half point below the national average.

While this represented an improvement in scores over 1996, the average for the tests for the same time period dropped below the national average by about three-quarters of a point (Bull, 2001).

National Science Educational Standards

The National Research Council coordinated an effort to develop national science standards in 1991. Over 40,000 copies of the Standards were distributed to school communities. The Standards were developed to generate improvements in instruction and the curriculum to achieve science literacy *for all students* according to Richard Klausner, chair of the National Research Council's science education project and director of the National Cancer Institute. The guidelines established by the report cited "local control" as the "hallmark of American education." Furthermore, the report noted, "teachers are the key decision-makers in determining what students will learn." The

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Standards were developed to provide guidelines for science content, science teaching, professional development, assessment, science education programs, and the science education system (National Research Council, 1995).

Included within the framework of the Standards, is a provision to "select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students; and, select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners." The report encourages science curriculum development specialists and educators to fully integrate and coordinate the various program components. The report addressed continuous program assessment in an effort to "use a variety of strategies." Those who framed the National Science Education Standards have stated the science content "must be embedded in a variety of curriculum patterns that are developmentally appropriate, interesting, and relevant to student's lives" (Weiss, 2001).

The report continues:

> Effective science curriculum materials are developed by teams of experienced teachers, scientists, and science curriculum specialists using a systematic research and development process that involves repeated cycles of design, trial teaching with children, evaluation, and revision. Because this research and development process is labor intensive and requires considerable scientific, technical, and pedagogical expertise, teachers and school district personnel usually begin the design and development of a curriculum that meets local goals and frameworks with a careful examination of externally produced science materials. These materials are modified and adapted to meet the goals of the district and of teachers in that district, and to use the resources of the local community (Wright, et. al., 1998).

Research

Auditory research shows comprehension levels of the listener are higher when the listener knows the speaker (Handel, 1989). In similar studies, auditory specialists have

discovered that when a visual image of the speaker is displayed electronically, comprehension of the content by the learner improves (e.g., MacLeod & Summerfield, 1987). The visual image of the speaker facilitates comprehension and serves as a redundant message for reasons unknown to researchers (MacDonald et al., 2000). While these studies examined video images in reference to understanding listening comprehension and various distractions related to speaking and understanding, there appear to be some important issues addressed in this research that are relevant to achievement in high schools and specifically, the applications of video technology in science classrooms.

Objective 1a—Achievement-- Research

About 200,000 Indiana eighth grade students representing 50 schools completed the ninety-minute, Third International Mathematics and Science Study in 1999 (TIMSS). Thirty-eight countries and thirteen states compared math and science performance and learning context. Sixty-nine percent of Indiana middle school students scored above the national median in math, and 72 percent scored above the national median in science. Out of thirteen states participating, Indiana students ranked third in math and science according to reports issued by the governor of Indiana. The TIMSS competition showed that Indiana eighth graders scored significantly higher than the international average and the United States average for math and science (O'Bannon, 2001). These data indicate strongly that Indiana elementary science programs may contribute to science literacy as defined by the National Science Educational Standards. And while scientific literacy may evident among elementary and middle schools in the state of Indiana, a review of Advanced Placement— a high school college preparatory program published by the College Board-- scores reveal the following:

> Indiana has committed resources to provide greater access to AP programs during the last decade; however, the state lags behind the nation in the AP test-taking rate;

Indiana's students have had greater access to AP programs over the last four years but the performance on AP examinations has declined during the same time period;

Indiana lags behind three neighboring states—Illinois, Michigan, Ohio—and ranks 47th out of 50 states in students who earn a score of 3 or better on AP examinations (Bull, 2001; American School Board Journal, 2002);

Indiana AP science exam scores have improved since 1996; however, science scores are far behind national averages and behind AP exam scores in English language and mathematics (Bull, 2001).

Serious questions arise as to why Indiana middle school students score significantly above the national and international test score averages and state high school students fall far behind most states in AP science exam scores. This proposal is designed to examine the effects of technology on student achievement in science. Furthermore, the educational component will contribute toward identifying instructional strategies to assist students to achieve the Standards. This study seeks to examine the effects on student achievement when computer, audio-visual materials produced by teachers are used in AP science classes. We intend to measure the achievement levels of students who are exposed to authentically integrated, audio-visual materials.

Authentic Integration of Technology and Teacher Feedback

The initiatives demonstrated by the learner to maintain behaviors to achieve have been defined as volitional processes (Corno & R. Kanfer, 1993; Snow, Corno &

Rohrkemper, (1985; Snow, Corno, & Jackson, 1996). Volitional control studies give credibility to the premise that the relationship between the teacher and student may be developed and maintained to lead to optimum learning. Butler and Winne (1995) argued that students hold particular beliefs about learning and these convictions become a type of "knowledge" that influences motivation. Research has shown that students functioning with a weak or ambiguous knowledge base in content areas are less likely to revise their views or correct misconceptions linked to content areas (Butler and Winne, 1995; Nichols and Steffy, 1999). However, students are likely to consider new knowledge and evaluate their views as a result of feedback (Pintrich and DeGroot, 1990). Carver and Scheier (1990) hypothesized that when the rate of achievement is lower than the learner expects as a result of internal feedback, a negative effect may follow. Negative effects embraced by learners who aspire to achieve quickly might very well manifest a chain of reactions leading to the abandonment of the task completely (Carver and Schierer, 1990).

There are no studies found to show implementation of computer technology contributes to higher student achievement at any level; however, examining student achievement and the results of authentic integration of technology may shed light on the relationship between technology use; more specifically, the dissemination of student grades via electronic video mail, and motivation habits adopted by students. Teachers issuing video grades may be able to establish and maintain a new relationship with the students due to increased communication about student goals. The improved communication may contribute toward acquiring stronger knowledge base of the learner by adding clarity in the content areas. The particular beliefs held by students about learning may include misconceptions that can be addressed by information contained within the teacher's narrative video grades. Misconceptions about content can be addressed by the teacher's video review—video grade-- of the student's work. As a result of video grades, the students will have additional opportunities to revise their views and correct their misconceptions. Highly motivated students who commonly pursue AP classes may require more feedback than regular education students. The medium of technology allows the teacher to supplement the information included within grades effectively and well. The preliminary research on the effects of technology and

achievement will assist researchers who look at self-regulation, learning goals, persistence, and other motivation characteristics.

Objective 2a Gender—Research

Women currently make up less than 20 percent of the nation's professionals in engineering and physical sciences (Farmer, 1997). Research on gender shows that girls in school are encouraged to seek assistance from others as well as provide help. This may hinder self-reliance, autonomy, and a competitive spirit; typically the characteristics found in males. These researchers found data to show that in science classes, girls are expected to do "good work" and receive a reward from the teacher (Etkowitz, Kemelgor, Neuschatz,& Uzzi, 1994). According to Farmer,

> "Society doesn't give girls support for their careers in the way it does boys," In regard to science and math, girls function in an "environment (that) neither encourages nor discourages," Boys may become intrinsically motivated to pursue science given the traditional grade system; however, girls may not find reasons in science classes to remain inquisitive (Farmer, 1997).

The effects on achievement on girls of video supplemental materials and video grades may provide some insights into gender differences and science achievement. The proposed project will examine the achievement in AP science classes and look at the effects of video instruction on gender.

Objective 3a (FD/I) Learning Styles-- Research

Witkin, et. al. (1971), defined cognitive style differences as field dependent and independent (FD/I) (Alper, 2002; Aragon, Johnson, & Shaik, 2000; Sullivan, 1998).

Learning styles identified as field dependent and field independent describe the extent to which comprehension of information is affected by the surrounding perceptual or field, or, "the extent to which the organization of the prevailing field dominates perception of any of its parts" (Witkin, Oltman, Raskin, & Karp, 1971). A field dependent learner keeps the different parts of the problem or challenge separate from one another, ignoring those that are meaningless for the purpose of solving a problem or finding a solution. The field dependent person reacts to the complex as a whole without analyzing it, responding on the basis of what it does to him rather than what he does with it (Sullivan, 1998).

Field dependent learners are global, attentive to social attributes, influenced by format, affected by stress and desire or require structure; conversely, field dependent learners tend to be externally directed. Field independent individuals are experimental, analytic, internally directed, philosophical, cognitive, individualistic. They typically generate their own hypothesis, are less affected by format or structure, and tend to ignore external stress. When field dependent learners interact with stimuli, they find it difficult to locate the information they are seeking because other information tends to mask important details. Field independent learners, on the other hand, find it easier to disambiguate information, that is, to recognize and select the important information from the surrounding field (Aragon, Johnson, & Shaik, 2000).

The Group Embedded Figure Test (Wiltkin, Oltman, Raskin and Karp, 1971) will be administered to each student participating. The students will be classified as field-independent or field dependent. The classifications will be based on the mean and standard deviations of the GEFT. The analysis of variance (ANOVA) will be used to look at the relationship between achievement--AP scores-- and learning styles. Groups of learners will be designated according to those who participated in the video instruction and their learning style (FD/I), achievement and gender. Achievement levels will be discerned based on AP test scores and grade point averages.

Significance

Numerous studies have looked at the relationship between distance education and learning styles. However, this proposed study looks at data comparing learning styles and exposure to authentically integrated audiovisual instruction. When we compare the mean scores of AP examinations of field dependent learners with field independent learners, we will identify any statistically significant effect audio-visual instruction has on learning styles of high school students participating in AP science classes.

Learning Styles Research

Students were grouped according to learning styles. The Group Embedded Figure Test (Witkin, Oltman, Raskin and Karp, 1971) was used to classify the participants into field-independent (FI), field-dependent (FD) learners. In this test, a subject is given a figure and asked to extract the embedded figure from a field of figures. The score of the test ranged from 0 to 18. A score of 18 indicated high field independence while a score of 0 reflected high field dependence. Pre and posttests were administered to compare student achievement.

Summary

The effects of authentic integration of technology on AP courses will provide valuable insights into attributes linked to student achievement. Referencing the Standards with AP classes will ensure accountability with regard to national reform initiatives. The data will enable researchers to look critically at demographics, gender, achievement, and learning styles and the effects of technology in the classroom. The AP proposed staff development sessions will augment state and national efforts to sustain a high school enrichment program. The authentic integration of technology offers numerous opportunities research, teaching, and service. Video technology will become more efficient and more effective as we expand video technology capacities in the immediate

future. As an assistant professor in educational leadership, research on technology provides me with the opportunities to remain current with research and practice in the high school environment. The proposed research compliments the technology plans of IPFW and Purdue University and the commitment of the administration to make significant contributions to assist schools to implement Standards and improve k-12 instruction for all students.

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